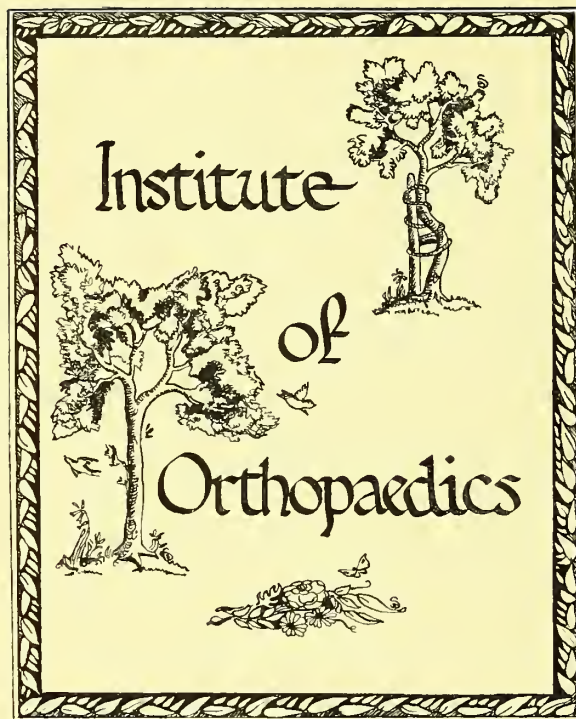




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EDINBURGH GAZETTEER.

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OR

GEOGRAPHICAL DICTIONARY;

COMPRISING A COMPLETE BODY OF

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PHYSICAL, POLITICAL, STATISTICAL, AND COMMERCIAL.

ACCOMPANIED BY AN

ATLAS,

CONSTRUCTED BY A. ARROWSMITH,

HYDROGRAPHER TO THE PRINCE REGENT.

EDINBURGH:

PRINTED FOR ARCHIBALD CONSTABLE AND COMPANY, EDINBURGH; AND
LONGMAN, HURST, REES, ORME, AND BROWN, LONDON.

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EDINBURGH, 1st December, 1817.

MEMOIR
ON THE
CONGENITAL CLUB FEET
OF
CHILDREN.

Printed by George Ramsay & Co. 1818.

A
MEMOIR
ON THE
CONGENITAL CLUB FEET
OF
CHILDREN,
AND ON
THE MODE OF CORRECTING THAT
DEFORMITY.

BY ANTONIO SCARPA,
EMERITUS PROFESSOR AND DIRECTOR OF THE MEDICAL FACULTY OF THE IMPERIAL AND
ROYAL UNIVERSITY OF PAVIA.

TRANSLATED FROM THE ITALIAN

BY
J. H. WISHART,
FELLOW OF THE ROYAL COLLEGE OF SURGEONS, AND ONE OF THE SURGEONS OF THE
ROYAL INFIRMARY AND DISPENSARY OF EDINBURGH.

WITH FIVE ORIGINAL ENGRAVINGS BY ANDERLONI.

EDINBURGH:
PRINTED FOR ARCHIBALD CONSTABLE AND COMPANY,

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1818.

ADVERTISEMENT.

IT has long been a prevailing opinion among practitioners, that little or no advantage can be derived from any remedies that can be employed for distorted limbs, and they have therefore seldom attempted to cure them ; in consequence of which, this branch of practice has been almost universally trusted to instrument-makers, or professed bone-setters. A great variety of machines have, however, been invented, and a number of methods proposed, for restoring distorted feet to their natural position ; but the number and variety of these prove, that no adequate means have hitherto been discovered for curing this deformity ; and that the proposed methods are still far removed from perfection. In some, the pressure of the apparatus is too violent, or it is very dif-

difficult to apply it correctly ; in others, it acts properly on the bones, but not at all on the muscles, or *vice versa*. In one case, the patient must be confined for months in the recumbent posture, which is not only very disagreeable, but often very injurious to the general health ; in another, the patient suffers severe pain ; or redness, swelling of the limb, and similar affections ensue, in consequence of the interrupted circulation. Some of the instruments are so complicated and so difficult of application, that they cannot be adapted to general use ; others require constant changes, and the daily attendance of a skilful surgeon, which is frequently impossible in the circumstances of the patient.

Various opinions have been entertained with regard to the proximate cause of club feet. Bruckner maintained, that it depended upon the *os naviculare* being removed too far inwards, and at the same time turned so that its under surface was placed obliquely inwards, and the tuberosity directed obliquely upwards. Naum-

burg asserted, that the club foot arose from a deviation of the astragalus outwards, in consequence of which, its upper surface was not applied to the extremity of the tibia, but rather to its inner cartilaginous surface. Jörg, a modern German author, considers the proximate cause to consist in a morbid action of the muscles.

I have not had an opportunity of dissecting any cases of club feet; but Professor Scarpa has adduced so many arguments in support of his account of the nature of the deformity, that we can scarcely hesitate in considering the statements of former writers as erroneous, or founded on examinations made at an advanced period of life.

Dr Colles of Dublin has lately published an account of a simple and ingenious apparatus for curing club feet, and he mentions several cases, where, in infants under six months old, it had been employed with success; but he candidly acknowledges that his trials with an apparatus

of similar form, but of much greater strength, had failed in children from three to twelve years of age. Dr Colles has also very accurately described the appearances of the deformity in a child of five years of age, which he had an opportunity of dissecting; and this account differs considerably from that of Professor Scarpa.

About the end of the year 1805, I first became acquainted with the following Memoir, which had been translated into the German and French languages; and at that time, I gave a drawing of the apparatus to Mr Still, a cutler of this city, now resident in London. He found no difficulty in constructing it, and it was employed with success in several cases; and I have been informed, that he still continues to make it for sale.

Having mentioned to Professor Scarpa, in the course of my correspondence, that this Memoir had not been translated into English, and that it would be perhaps difficult to get the Plates exe-

cuted in a proper style in this country, he very obligingly sent me Sets of the Original Engravings for Two Hundred Copies, to which number the impression of this Work is therefore necessarily limited.

In a case of slight deformity, which came on in a girl about five years of age, in consequence of debility, after a long confinement in a severe case of hooping-cough, I used Bruckner's bandage with complete success; the patient, for a considerable time afterwards, being made to wear laced boots, the sole of which was made thicker on the outer side. But whatever method of cure be adopted, it may be safely asserted, that the prospect of success will always be in proportion to the age of the subject, and it may, in most cases, be effected in a very short time, if undertaken soon after birth.

EDINBURGH, *June* 1818.



A
MEMOIR
ON THE
CONGENITAL CLUB FEET
OF CHILDREN, &c.

THE public has, for many years past, been informed, through the medium of newspapers, handbills, and notices, in an empirical style, that Venel in Switzerland, Tiphaisne and Verdier in France, and Jackson in England, employed successfully a new method of curing the congenital club-feet of children, by means of some peculiar machines of their invention, the application of which did not occasion pain or inconvenience of any kind to the little patients, such as are excited by the hard boots of leather, and the heavy machines of iron, which are delineated in the works of the most celebrated writers on surgery, both ancient and modern. The action of these machines is, indeed, very violent, intolerable, and ill calculated to fulfil the intention with which they are applied ; and is sometimes directly contrary to the power which is required for correcting this kind of deformity.

§ 2. The veil of secrecy which, for reasons easily to be divined, the above mentioned authors have assumed, does not indeed deprive these really ingenious men of the merit of having performed very wonderful and surprising cures, and of having given, by facts, numerous proofs of the usefulness of their acquirements in this branch of surgery. But although many years have elapsed since the publication of their advertisements, it still continues a profound mystery, guarded with jealousy by a few, what their indications of cure are, what are their machines, and in what manner they are applied, in order to produce their beneficial effect. Bruckner,* on the information of others, has given an account of Venel's machine; but I must own, that I do not sufficiently understand either the construction or the application of this piece of mechanism. Besides, if Venel's machine, according to Bruckner's account, acts by squeezing the distorted feet between plates of iron; and still farther, if this machine requires that the children should remain at perfect rest during all the time of the cure, which sometimes exceeds a year and a half; although, in opposition to the authority of numerous cases, we cannot doubt that both Venel and others subsequently have obtained wonderful

* Ueber einwärts gedrehte Füße, und deren Behandlung, besonders nach Dr Venel's Methode. Bruckner had this information, as it is usually expressed, at second hand; as the young physician, Wantzel, who had been cured of this disease by Venel, in the course of twenty-two months, afterwards communicated to Dr Ehrmann all that he had observed with regard to it; and the latter imparted it to Bruckner. See Ventzel, *Dissert. de talipedibus varis*. Tubingæ, 1798.

and perfect cures ; yet, strictly speaking, we cannot allow that Venel's apparatus combines all those degrees of perfection that are desirable, as was announced by himself and others during his lifetime. Bruckner * has likewise described a bandage of his own invention for curing congenital club feet, by gentle means, and for keeping them in the proper position. This bandage I have seen employed, with success, in a case of moderate deformity, under the direction of our skilful surgeon, Dr Volpi ; but I have great doubts whether this bandage would be sufficient to effect a permanent cure of great congenital deformities of the feet. Bruckner's bandage is likewise liable to the same objection as Venel's machine, that of obliging the child to be kept at perfect rest for many months ; for Bruckner himself expressly states, that " Venel's machine, as well as his own bandage, does harm instead of good, if the child be allowed to

* The following is the mode of applying Bruckner's bandage. Take about a square yard of flannel, and fold it in a triangular shape, the apex of which is to be folded over as often as is required, to give the whole cloth the shape of a roller, the middle of which is about the breadth of two fingers. One end of this bandage is to be applied obliquely from below the calf of the leg to the tendo Achillis, and it is to be given to an assistant to hold. The other end of this bandage is carried above the outer ankle upon the upper part of the foot, over the inner ankle to the tendo Achillis, and again obliquely downwards over the upper part to the sole of the foot, and from it on the outer edge of the foot, keeping the bandage always tense, so that, by these two turns, the fore part of the foot is gradually turned and drawn from within outwards. Having done this, take the two ends of the bandage, and cross them tightly over the outer edge of the foot, near to the outer ankle, making a knot similar to that used by merchants in packing their bales of goods ; and, lastly, finish by a turn round the ankle and a common knot.

walk about." This circumstance, every one must perceive, renders this kind of treatment very imperfect, or, at least, only applicable to cases of slight deformity, and in children soon after birth, or before they begin to walk.

§ 3. For some time past, guided by the precepts of Hippocrates, where he speaks of these imperfections of the feet, and from some confused hints which I had been enabled to collect, when in Paris, in the year 1781, during the lifetime of Tiphaisne, I have been engaged with the important object of discovering a simple kind of apparatus, to act constantly in reconducting the distorted foot to its natural shape and direction with the tibia, without occasioning pain, or any considerable inconvenience to the children, and without their being obliged, during the cure of their feet, to be confined many months to bed, or at perfect rest, with the risk of injuring their general health. I can now affirm, that I have obtained the object which I had in view. Experience has confirmed the efficacy of the method of cure, which I propose to describe in this essay, and which I am anxious to publish as early as possible, in order that the poor may immediately enjoy this benefit as well as the rich, which seems hitherto to have been reserved only for the latter. I am not aware whether the apparatus, I am about to describe, be wholly, or in part, that of the late Tiphaisne, or that employed, at present, by Verdier in Paris, or by Jackson in London; but the knowledge is, in my opinion, of little importance to the public, provided that which I pro-

pose produces the same good effect, and satisfies the above mentioned indications of cure. I hope, nevertheless, that this memoir, although intended chiefly for making known a plan of cure hitherto unknown to the greater number of surgeons, may also be attended with another important advantage, viz. that of exciting a generous emulation among those few who have hitherto made a secret of this branch of surgery; and that they, induced by motives of honour as well as of humanity, and of public utility, will suggest new methods, if they possess any, or may add, to what I have said on this subject, reflections suggested by long practice in treating this sort of deformity.

§ 4. The twisting of the foot, inwards or outwards, is sometimes *congenital*, and sometimes occasioned after birth, by internal or external causes. The *congenital* distortion is what I chiefly propose to treat of here. This deformity, if not always, occurs most frequently with the point of the foot turned inwards and upwards; in consequence of which, the children, in walking, place the foot on the ground on its outer margin,* and as it were on the outer malleolus. In great degrees of this deformity, the point of the foot is so much turned inwards, that it forms with the tibia a very acute angle internally, obtuse externally. Sometimes one, sometimes both feet are deformed, and when both are affected, the points of the feet approach so near, that they

* Tav. II. Fig. 1. *b. c.* Sauvages, Nosolog. Method. *Loxarthrus interarticularis*.

almost touch each other. The thigh and leg preserve their natural shape ; not unfrequently, however, the one or other of the knees projects a little inwards or outwards. The internal malleolus is very slightly, or not at all prominent ; the external, on the contrary, projects considerably, and is apparently situated more downwards and backwards than usual ;* from which circumstance it appears, as if the two bones of the leg had been turned in such a manner, that the internal malleolus is carried forwards, and the external backwards. But on examining attentively, it is evident that this distortion is not absolute, but relative, arising from the flexure of the fore part of the foot inwards ; and that the two malleoli, as well as the *astragalus*, are completely, or nearly, in their natural position, as shall be afterwards demonstrated. The posterior tuberosity of the heel appears entirely wanting, in consequence of its being turned towards the inner side of the foot, and drawn a little upwards towards the calf of the leg. When the child stands on his feet, therefore, the heel does not touch the ground. The upper part of the foot is very much elevated, and is unusually prominent about its middle, which renders it irregular. The sole of the foot is quite concave, and, as it were, deeply furrowed lengthwise. The great toe is kept separated from the other toes towards the inner margin of the foot, and it is the more removed from the other toes, the more firmly the child presses on the ground.

* Plate II. Fig. 1. a.

The toes are not arranged horizontally, but rather in a vertical line to the sole of the foot. The external margin of the foot, on which the whole weight of the body gravitates, is of a semicircular shape, and a certain portion of it * is covered by a hardness or callosity, under which is felt, deep-seated, an yielding elastic substance. In consequence of the situation of the heel, the tendo Achillis is carried obliquely from the outer to the inner side of the leg, and is in a state of permanent tension. Children so much deformed in their feet from birth, cannot walk but with great difficulty, and only by raising and carrying one foot before the other in a semicircular direction. When they raise one foot, they are in danger of falling forwards or backwards, because the line of direction of the whole body, which gravitates on the foot resting on the ground, does not, in them, fall directly on the top of the tarsus, but on the place where there is no posterior projection of the heel, as in the natural state, or it falls to the outer part of the external malleolus. They totter still more, if one of their knees is turned a little inwards or outwards, which complication of deformity is sometimes conjoined with that of the feet.

§ 5. In very young children, we do not find any difficulty in turning the feet in a contrary direction to the deformity, simply employing the hand, and without occasioning them any pain. On the first attempt which is made to

* Plate II. Fig. 1. *b*.

bring the distorted foot to its proper position, we observe that the prominence, which produced the irregularity of the upper part of the foot, diminishes, and then entirely disappears; but when the foot is left to itself, it returns immediately to the deformed position. The leg, as has been mentioned, is, for the most part, properly shaped, but slender, especially at its middle, and emaciated when compared with the rest of the body of the child. For this I am unable to assign a plausible reason, unless we allow that a certain reciprocity of connection and of harmony between the parts is required for their proper nourishment, perfect developement and increase, in addition to the freedom of the circulation, the perviousness and distensibility of the small vessels. For it is evident, that the mere want of exercise alone has no sensible influence, in these cases, in producing and keeping up this slenderness of the leg; as in some children, kept at rest for many months during the cure, in proportion as their feet are brought right, the legs acquire their nourishment, size, and strength.

§ 6. On dissecting the feet of such unfortunate children, we find that the bones of the tarsus are not, properly speaking, *dislocated*, but merely *removed*, in part, from their mutual contact, and *twisted* around their smaller axis.* This

* Hippocrates was acquainted with this fact, for he wrote in his book, *De Articulis*, *Modus mutilationis non unus est, sed plures. Plurima quidem cluxata non sunt penitus, sed per figuræ consuetudinem in quadam pedis interceptione mutilata.—Translation of Mercurialis.—Translation of Foesius. Vari, igitur non uno modo, sed pluribus fiunt.*

displacement and twisting round the smaller axis, are more remarkable in the *os naviculare*, the *cuboides*, and *os calcis*, and much less in the *astragalus*, without, however, either of these bones quitting entirely the cavity, or *acetabulum*, in which they are contained.

§ 7. The *os naviculare*,* the deep elliptical cavity of which receives the smooth articular head of the *astragalus*, is found turned round its smaller axis, so that its apex, or internal tuberosity, † which, in the well-shaped foot, is situated horizontally from the inner margin to the dorsum of the foot, is turned obliquely upwards towards the internal malleolus. ‡ The other apex, or *external* § tuberosity of the *naviculare*, which ought to be in a horizontal position, or transversely on the upper part of the foot, is turned obliquely downwards. It is the more oblique the greater the twisting of the foot inwards, and even greater than that delineated in Plate I. Therefore, it necessarily follows, that the inner margin of the foot, in consequence of this turning of

Plerumque siquidem non ex toto sede sua elapso articulo, sed quod re aliqua detentu eo habitu assueverit pes *varus* efficitur. *Sauvages, Nosolog. Method. Loxarthrus.* Est ossium cum motu sensibili articulorum situs relativus in alienum constanter mutatus, aut obliquitas respectiva persistens citra exarthrema et spasmus. Caput ossis nativum acetabulum servat, nec desinit acetabulum caput ossis sibi dicati excipere; mutatur constanter in perigrinam directio nativa, qua sibi respondent ossa mobiliter combinata, quin contractioni spasmodicæ hoc veniat tribuendum, exulant itaque ab Loxarthri genere exarthrema et spasmus; una peccat ossium positura respectiva, et coincidentia nativa, quæ in alienas mutatæ permanent.

* Plate I. Fig. I. 7.

† Plate I. Fig. I. 8.

‡ Plate I. Fig. I. 3. Fig. II. 2, 3.

§ Plate I. Fig. I. 9.

the *os naviculare* around its lesser axis, forms a very acute angle internally with the tibia, and with the internal malleolus, and that the smooth articular head of the *astragalus** being no longer included and covered completely by the cavity of the *os naviculare*, but only by about a third of its circumference, forms, with that part of it which remains uncovered, an unusual prominence on the upper part of the foot, although, strictly speaking, this portion of the articular head of the *astragalus* is not at all, or very little, displaced from its natural situation and direction † with the tibia.

§ 8. The *os cuboides* ‡ likewise is found turned round its smaller axis, in the direction from the upper part of the foot by the outer side to the sole of the foot. At the place where the *cuboides* is in contact with the anterior tuberosity of the *os calcis*, it makes an angle obtuse § externally, and acute internally, or on the side looking towards the sole of the foot. It, therefore, leaves uncovered, on the outer margin of the foot, a portion of the articular surface of the anterior tuberosity of the *os calcis*, with which, in the healthy state, the *os cuboides* is in exact continuity. At the place where these two bones ought to be in mutual contact, the ligaments passing from the one to the other are so relaxed that they leave a pit, || which is perceptible, even when the

* Plate I. Fig. I. 6.

† Plate I. Fig. I. 10.

|| Plate I. Fig. I. 12

‡ Plate I. Fig. I. 5, 6.

§ Plate I. Fig. I. 12.

foot is covered by the integuments. The turning of the *os cuboides* round its smaller axis, by the outer margin to the sole of the foot, and the obtuse angle, which this bone forms externally with the anterior tuberosity of the *os calcis* on the outer margin of the foot, contributes very much to give to the whole foot the semicircular shape from below the external malleolus forwards as far as the little toe.

§ 9. The *os calcis*,* where it joins the inferior articular surface of the *astragalus*, is turned round its smaller axis, from the inner to the outer side of the foot; that is, it is inclined externally from the fibular aspect, and from the external malleolus, so that its anterior tuberosity is directed downwards, its posterior tuberosity inwards and upwards, and its body is bent under the sole of the foot. In consequence of this, a line drawn from the posterior projection of the *os calcis*, where the tendo Achillis is inserted, by the outer side of the foot, forms a very wide semicircle. The inclination outwards and downwards, towards the sole of the foot, of the body of the *os calcis*, necessarily leaves, uncovered, a portion of the inferior articular surface of the *astragalus*. It is farther to be remarked, that the posterior surface of the *os calcis*, which, as has been mentioned, is turned under the sole of the foot, from without inwards and upwards, is always thinner than in well-shaped feet; and that there is not the usual prominence or roughness on its

* Plate I. Fig. I. 11.

outer surface, where the *abductor* muscle of the little toe is attached ; and, lastly, in this deformity of the feet, that portion of the body of the *os calcis*, on which the neck of the astragalus usually rests, does not extend forwards.

§ 10. The three *cuneiform bones*,* the *metatarsal*, and those of the toes, necessarily follow the diseased turning round their axis of the *naviculare*, *cuboides*, and *os calcis* ; and, therefore, it follows, of mechanical necessity, that the toes of the *congenital* club foot do not rest horizontally on the ground, but in a line nearly vertical to it. And likewise, the posterior head of the metatarsal bone, supporting the little toe, which, in the well-formed foot, projects outwards in a parallel direction to the ground with the outer edge of the foot is, in the deformed state, found concealed under the sole of the foot.

§ 11. On the sole of the club foot, turned inwards from birth, as well as on its upper part and sides, we observe, equally distinct, the morbid turning inwards of the body of the *os calcis*, † and the unnatural curvature of its posterior tuberosity ‡ towards the inner-margin of the foot, and upwards in the hollow of the sole. The internal protuberance of the *os naviculare* § is turned obliquely upwards towards the internal malleolus, || and is almost in contact with

* Plate I. Fig. I. 13, 14, 15.

† Plate I. Fig. II. 6.

‡ Plate I. Fig. II. 2.

† Plate I. Fig. II. 5.

§ Plate I. Fig. II. 3.

it, and its external protuberance is turned obliquely down towards the toes, more especially opposite to the superior head of the second bone of the *metatarsus*. The external margin of the *os cuboides* * being inclined towards the sole of the foot, forms a very acute angle with the articular surface of the anterior tuberosity of the *os calcis*, when viewed from the sole of the foot. Lastly, we find the metatarsal bones turned round their axis, and those of the toes from within outwards, and brought nearer than usual to the heel. This direction of these bones gives to the upper part of the foot a greater convexity than natural, and renders the sole of the foot more concave.

§ 12. According to the observations which I have made on young children, the *astragalus*, † at its union with the inferior extremity of the tibia and fibula, has the least share of all the bones of the tarsus, in the congenital distortion of the foot inwards. For I have found, that in children, even in the greatest degree of this deformity, the *astragalus*, compared with the other bones of the tarsus, is very little, or almost not at all inclined internally, or towards the internal malleolus, and that its anterior tuberosity, or the articular ‡ head of this bone, which, on the upper part of the foot, is received into the *os naviculare*, retains very nearly its natural direction and position with the tibia and the malleoli.

* Plate I. Fig. II. 4.

† Plate I. Fig. I. 5.

‡ Plate I. Fig. I. 6.

In consequence of this, as I have already mentioned, this articular head of the *astragalus*, denuded in a great measure by the turning of the *naviculare* round its smaller axis, forms a prominence on the upper part of the foot, which, at first sight, appears unnatural, but which, in fact, is perfectly so, because this prominence does not depend on the wrong position of the articular head of the *astragalus*, but on the morbid rotation of the *naviculare* round its smaller axis, leaving the articular head of the *astragalus* denuded. In confirmation of this fact, when, in very young children, we endeavour, with the hands, to turn gently the point of the foot from within outwards, the prominence on the upper part of the foot disappears entirely, or in a great measure, not because the articular head of the *astragalus* is restored to its situation, but because the *naviculare* is brought back to cover the articular head of the *astragalus*; just as a person does, to use the expression, when they cover their head with their hat, which has been inclined to one side. * And it is a singular circumstance, that while, in all cases of luxations hitherto known, or of subluxations, which take place in joints formed by an articular head received into a deep cavity, it is always the round head which is displaced from the

* Wantzel is of the same opinion, *loc. cit.* p. 34. Parum vero sub hujusmodi exercitio astragalus loco movetur, sed os naviculare, quod pilei quasi in modum capiti hujus rursus imponitur, id ipsum occultat, neque amplius digitis attingi ut possit sinit, quod sensim quoque sensimque in pedis diorthosi observari potest. Cujus rei fugitivo forte intuitu decipi quidam potuere, ut morbi essentiam in solam astragali subluxationem, quin laxationem ponerent.

cavity, or *acetabulum* ; in the displacement under consideration, it is the *acetabulum* which changes its position, while the round articular head remains in its natural place.

§ 13. In making this assertion, I do not pretend to say, that the *astragalus*, in this congenital deformity, is never, in the slightest manner, inclined to the internal malleolus ; for I allow that it is sometimes a very little, or even considerably so, in adults, who have had this malconfirmation from birth. All that I mean to assert is, that, in infants who have not begun to walk, this obliquity of the body of the *astragalus* is very trifling when compared with that of the other bones of the tarsus, in the congenital club foot turned inwards. Camper* is of a different opinion. But it is probable, that this celebrated anatomist had only examined the congenital club foot turned inwards of an adult subject, who had made use of his feet for several years. In this case I have also observed, that, from the long pressure upon the sole of the foot, and the walking upon its outer side, and the oblique direction acquired by the tendons of the muscles inserted into the tarsus and toes, in course of time the *astragalus*, at its union with the tibia, and with the external malleolus, is likewise inclined very much inwards, and becomes so much deformed and so small, that it seems as if it had been compressed and wasted. The same conclusion may be drawn from the ob-

* Sulle Scarpe, e dei mali da esse cagionati.—Dissert.

servations of Bruckner and Wantzel, and the latter has given a description of the bones of the tarsus of a congenital club foot turned inwards, which he examined in a young man, thirteen years of age.* But I again repeat it, the fact is otherwise in infants and in little children, at least as late as the fourth year, in whom the *astragalus*, compared with the other bones of the tarsus, is less displaced than all the other bones of this class. In short, if we examine attentively the well-shaped foot of a tender infant, we perceive by the eye, as well as by the touch, a great mobility in the junction of the *naviculare* with the articular head of the *astragalus*, and an evident easy yielding in the union of the *cuboides* with the anterior protuberance of the *os calcis*, so that, at these two joints, the foot may be twisted inwards and outwards, in a manner nearly similar to that of pronation and supination of the hand. But a serious difficulty, which cannot be overcome without occasioning pain to the child, is met with at the seat of the articulation of the *astragalus* with the tibia, whenever we attempt to make the foot perform any other motion than that of flexion and extension with the leg. Now, supposing, as the greater number of surgeons believe, that the congenital distortion of the foot inwards, is derived from a constrained posture of the foetus in utero, it is more than probable that this morbid twisting of the bones of the tarsus ought to take place rather at the junction of the *naviculare* with the arti-

* Loc. cit. p. 18.

cular head of the *astragalus*, at that of the *cuboides* with the *os calcis*, and at that of the *os calcis* with the inferior articular surface of the *astragalus*, than at the *ginglymus* articulation of the *astragalus* with the tibia, and with the external malleolus, especially as the latter joint does not yield as the preceding to lateral or rotatory motions, and, consequently, does not at all favour the twisting of the foot inwards. As an additional proof of this, it is observed, that, in young children deformed in this manner, whenever we make attempts simply with the hand, in order to bring back their feet to the proper position and direction with the tibia, laying hold with one hand of the posterior tuberosity of the heel, and with the other the fore-part of the foot, in the act of attempting to make the reduction, we perceive, in the most clear and distinct manner, that the motion of rotation, in a direction opposite to that produced by the deformity, is made at the joint of the *os naviculare* with the articular head of the *astragalus*, and at that of the *cuboides* with the *os calcis*, followed by the *cuneiform* bones, and those of the *metatarsus*, while little or no motion is observed at the *ginglymus* joint of the *astragalus*, with the inferior extremity of the tibia, and with the external malleolus.

§ 14. In general, it is observed, that in this deformity all the bones of the tarsus are not, at a similar age, so completely developed as they are in well-shaped feet, both in

respect to the body of these bones, as well as their processes and tuberosities, and the degree of their solidity. But this difference of developement and of solidity is even more evident in adults, who have had this deformity from birth, than in children from the fourth to the sixth year; on which account I am satisfied that the descriptions of the state of the bones of the tarsus in the congenital club foot, will always differ from each other, according to the different degrees of the deformity, and the various ages from which these descriptions have been taken. It appears to me, that the essence of this congenital deformity of the feet consists in the twisting of the *os naviculare*, of the *cuboides*, and of the *os calcis*, around their smaller axis, into which morbid direction are drawn the *cuneiform* bones, those of the *metatarsus*, and of the *phalanges* of the toes, and that, comparatively, the *astragalus* is the least displaced of all the other bones of the tarsus.

§ 15. Any one acquainted with the doctrine of muscular motion; and the respective position and reciprocal action in the healthy state between the muscles and the articulations which they are destined to move, will have no difficulty in forming an exact idea of the state in which these organs of motion and their tendons are, which pass from the leg to be inserted into the congenital club foot turned inwards. This is more evident, if we attend particularly to what has been already pointed out with regard to the twisting of the

bones of the tarsus round their smaller axis, especially of the *os naviculare*, *cuboides*, and *os calcis*, and of the *cuneiform* bones, and those of the *metatarsus*. In consequence of this distortion, the foot is always in a state of adduction and of flexion with regard to the tibia. In these circumstances, it of necessity follows, that some of the muscles moving the foot, along with their corresponding tendons, are much shortened, and more tense than usual; others very much elongated and relaxed, in proportion as their fixed point is more or less removed from the seat of their insertion. In the case of such a deformity of the foot, to the class of muscles unusually shortened and tense, belong the two *tibiales* muscles, the *long flexor* of the toes, the *long flexor* of the great toe, the *abductor* of the great toe, (the shortening and tension of the last muscle increase, in proportion to the increase of the pressure made by the child on the ground;) lastly, the muscles of the calf united together in the tendo Achillis, viz. the *soleus*, *plantaris*, and *gastrocnemius*. To the second class, or those preternaturally relaxed and elongated, together with their tendons, are referred the *peronei* muscles. Duverney* was of opinion, that

* Traité des Maladies des Os, T. ii. chap. 3. " Les contorsions dépendent uniquement de l'inégale tension des muscles et des ligamens; car ceux qui sont extrêmement tendus tirent de leur côté, tandis que les autres obéissent par leur relachement. Comme ces pauvres enfans cherchent à se soulager, ils tournent ordinairement les pieds du côté où les muscles, et les ligamens sont le plus tendus, c'est-à-dire, du côté opposé au renversement; et c'est ce qui entretient la mauvaise figure des pieds."

the deformity of the feet we are now speaking of, was chiefly owing to the unequal tension of the muscles and ligaments; "for," he says, "those muscles and ligaments which become extremely tense, draw the foot towards them, while the other muscles and ligaments, which are relaxed only, follow the vitiated direction which the foot takes." On this point, it appears to me, that Duverney has confounded the cause with the effect. For, it may be proved by determinate facts, that the diseased twisting of the bones of the tarsus takes place first, in consequence of which the point of insertion of some muscles approximating, and of others receding from their fixed point, the former become shorter, and the latter are elongated. We frequently observe the same change occur in cases of fractures and dislocations.

§ 16. The want of equilibrium between these two classes of muscular powers, contributes very much to keep up the deformity of the foot twisted inwards, as well as uniformly to increase it in children as they advance in years; because the action of the *peronei* muscles, not being sufficient to counterbalance the force of the two *tibiales*, especially of the *anterior tibialis*, the foot is drawn constantly more inwards and upwards by the *tibiales* muscles. The combined force of the two *tibiales* and *peronei* muscles not being sufficient to equilibrate the retraction of the muscles of the calf of the leg, it follows, of necessity, that the tendo Achillis is kept in

a perpetual state of tension.* The posterior tuberosity of the *os calcis*, into which this tendon is inserted, is dragged continually upwards, in an oblique line, from the inner to the outer side of the leg; and, lastly, the whole weight of the body must always gravitate more on the outer edge of the foot, the older the child is, and the more he exercises himself in walking. To all this is to be added, that, independent of the twisting around their axes, of the greater number of the bones of the tarsus, the inequality of force between the *peronei* and *tibiales* muscles, and between all these taken together, in opposition to those of the calf of the leg, causes, that both in standing and walking, the child being unable to keep the tibia and fibula in a firm position exactly perpendicular to the *astragalus*, he is, at every step, in danger of falling forwards or backwards, or to the one or other side. This produces a continual tottering, and, in walking, an awkward posture of the whole trunk.

§ 17. In the same manner as the tendons of the above-mentioned muscles, the ligaments which unite the bones of the tarsus to each other, and to the lower end of the tibia and fibula, are found in a state of unequal tension. For

* In dissecting a woman who had worn very high-heeled shoes, the following was the state of the muscles of the calf of the leg:—"Omnes turgore, et crassitie ceteris ejusdem corporis partibus carnosus paulo inferiores. Nihilominus nonnulli eorum tam ingentem in modum tensi deprehendebantur, ut ne per ingruentem quidem plures per dies putredinem relaxati fuerint. Inter hos primum locum occuparunt muscoli surales, quorum tendo, aptissima hic tensionis respectu similitudine, *chorda* vocandus." Wantzel, *loc. cit.* p. 28.

the *external* lateral ligaments, viz. the *perpendicular* and the *posterior*,* which unite the external malleolus to the heel, are unusually relaxed and elongated, while the *deltoid* † ligament which passes from the *internal* malleolus and is inserted into the *os naviculare*, and the *plantaris* ligaments, common to the bones of the *metatarsus*, are shortened, and preternaturally tense, as well as all the smaller ligaments of this kind destined for the same use.

§ 18. In consequence of what has been stated with regard to the particular manner of contortion round their lesser axis of the greater part of the bones of the tarsus, in the *congenital club foot turned inwards*, and with regard to the want of equilibrium between the muscular powers moving the foot, as well as of their tendons and ligaments, the indications of cure of this deformity will be, 1. To cause an insensible and gradual turning of the *os naviculare*, *cuboides*, and *os calcis*, and with these of the *cuneiform* and *metatarsal* bones, in a contrary direction to that which the deformity has produced, and, consequently, to bring back the fore-part of the foot into its proper and natural direction with the tibia. 2. To substitute for the deficiency of the activity of the external ligaments of the foot, but more particularly of the *peronei* muscles, an artificial force, capable not only of counterbalancing that of the tense internal liga-

* Weitbrecht, *Syndesm.* Tab. xxii. Fig. 64. e. 65. d.

† Ibidem g.

ments, and of the shortened *tibiales* muscles, but likewise of overcoming it, and of causing, by means of this artificial force, the external margin of the foot to remain, to use the expression, as it were, suspended upon the ground. 3. As soon as the equilibrium between the muscles of the tibia and fibula is restored, to promote, by means of the combined action of these two classes of muscles, the direct flexion of the foot upon the tibia, so that, as soon as the great tension of the tendo Achillis, and of the muscles of the calf of the leg, is overcome, the posterior tuberosity of the *os calcis* may be depressed, and brought into a proper direction with the sole of the foot, and that the foot may thus regain its aptitude for performing the motions of flexion and extension.

§ 19. The artificial force for effecting the first indication of cure, in order to produce the desired effect, ought at first to be very moderate ; it should then be gradually increased, but without occasioning pain, or any other sensible inconvenience to the little patients, and especially it must not prevent them standing on their feet, or walking. On this point, it is a fact well known to all scientific persons, that the soft parts of our bodies, particularly the muscles, tendons, and ligaments, are of such a nature, as to be capable of being elongated beyond what any person, ignorant of these matters, could have imagined. This elongation may be effected without occasioning pain, or any considerable uneasiness, provided the distending force is applied so as to

act in a gradually increased manner. On the contrary, strong and sudden straining, and violent compression, far from producing relaxation and elongation of the animal body, have a quite opposite effect, that is, occasion retraction, rigidity, and spasm of the same parts.

§ 20. Of all the machines which can be employed for supplying the debilitated muscular and ligamentous powers, there is none, in my opinion, better adapted than the Lever, because it acts uninterruptedly by its own elasticity. Its power may be gradually increased, according as is required, and by its oscillations it eludes the resistance, to use the expression, without ever ceasing to act in overcoming it. The apparatus intended for correcting the deformity of congenital club feet, which I am now to describe, consists of several *springs*, and as the cure of this disease is divided into two stages, the elastic apparatus likewise consists of two parts. The first is intended merely for turning the fore-part of the foot from within outwards, as far as its natural position and direction with the tibia. The second part of this apparatus is intended for retaining the fore-part of the foot in its regained natural position with the tibia, and with the external malleolus, and for correcting the heel, and retaining the tibia and fibula steadily perpendicular to the *astragalus*.

§ 21. The first part of this elastic apparatus consists of two *springs*, the one of which I shall call the *fulcrum*, the

other the *horizontal spring*. The fulcrum, or point of rest of the horizontal spring, * is made of a plate of fine elastic steel, bent so as to fit and embrace the morbid convexity of the external margin of the foot, from below the external malleolus forwards for about two inches or a little more, in a child of three years of age. From the greatest convexity of the fulcrum arise two little pillars, between which the *horizontal spring* is allowed to run easily backwards and forwards, and may be fixed by means of a screw. † Along the upper edge of the *fulcrum* ‡ are situated two knobs for fixing one of the straps. The semicircular spring, forming the *fulcrum*, is stuffed with a soft substance on its concave side, projecting about two lines beyond the edge of the spring. The substance best fitted for this padding is the *list*, or border of cloth, which combines softness with a certain degree of elasticity. The whole *fulcrum* is to be covered with soft glove-leather, except at the part where the screw is placed, intended for fixing the *horizontal plate* on the *fulcrum*.

§ 22. The *horizontal spring* § ought to be a little longer than the foot which is the subject of treatment, so that it passes beyond the heel, taking the measure from the root of the toes backwards. This *horizontal spring* must be of moderate elasticity or strength, so that it bends easily. On the

* Plate II. Fig. II. III. *a*.

† Plate II. Fig. II. III. *c*.

‡ Plate II, Fig. II. III. *f. f*.

§ Plate II. Fig. II. III. *b*.

anterior extremity is situated a knob * for the attachment of the anterior strap. The posterior extremity of the *horizontal spring* is perforated by small holes, through which the posterior strap is sewed to it.

§ 23. The anterior † of these two straps surrounds the sole of the foot at the root of the toes, and is attached to the anterior end of the *horizontal spring*. ‡ The portion of this strap, which passes round, and embraces the point of the foot, is stuffed with *list*, and covered with glove-leather; the rest of it, contiguous to its anterior extremity, is pierced with a series of holes near to each other. The posterior strap, § stitched firmly to the posterior end of the *horizontal spring*, is of a sufficient length to pass round the heel, and advance over the upper part of the foot to the top of the *semicircular spring* or *fulcrum*. This second strap, near to the place above mentioned, divides into two portions, || each of which is perforated by a row of holes at small intervals from each other.

§ 24. This elastic apparatus is applied in the following manner : ¶ A boot of fine glove-leather is put on the child,

* Plate II. Fig. II. III. *d*.

† Plate II. Fig. II. III. *i*.

‡ Plate II. Fig. II. III. *d*.

§ Plate II. Fig. II. III. *g*.

|| Plate II. Fig. II. III. *f.f*.

¶ Bruckner devoted the first period of the treatment to procure the relaxation of the shortened muscles and ligaments of the foot, by the application, morning and evening, for several weeks, of emollient ointments, warm baths, and friction on the

which covers the whole foot and leg, as far as the knee. The semicircular spring or *fulcrum* is then applied on the convexity of the outer margin of the deformed foot, from below the external malleolus to the whole *os cuboides*,* and it is adapted in such a manner that a considerable portion of the concave part of the *fulcrum* passes under the sole of the foot. After this, the *horizontal* † spring is made to run from behind forwards, until the point of the greatest convexity of this spring corresponds to the middle point of the *fulcrum*, and there the *horizontal* spring is fixed by the screw. ‡ The strap sewed to the posterior extremity of the *horizontal* spring § is passed round the heel, without compressing it at all, or scarcely even touching it; is carried over the internal surface of the neck of the foot, immediately under the internal malleolus, and rests upon the protuberance or superior apex of the *os naviculare*, removed upwards from its natural position. The two portions of this posterior strap are then fixed to the two small knobs || seated on the superior margin of the *fulcrum*. And in order that this strap may not press too much upon the internal surface of the neck of the foot, a soft cushion, formed of several folds of old

calf of the leg, and external malleolus; but in the course of my practice I have observed, that this may be entirely dispensed with, or that some of these means may be employed during the application of the first apparatus, by which a great deal of time is gained.

* Plate II. Fig. I. c. b. Fig. II. a.

† Plate II. Fig. II. c.

‡ Plate II. Fig. II. f. f.

† Plate II. Fig. II. b.

§ Plate II. Fig. II. g.

linen is placed under it. * This being arranged, we proceed to the application of the second strap. † This is passed round the point of the foot at the root of the toes ; and the point of the foot is carried with the hand gradually from within outwards, without occasioning pain to the child. The anterior strap is then fixed to the corresponding extremity of the *horizontal* spring, which is by degrees stretched by pressing its anterior extremity from without towards the point of the foot. During the first day, the *horizontal* spring is only drawn moderately tense ; afterwards the force of it is increased by drawing the anterior strap one hole farther, and so on, until the fore part of the foot is brought to its proper and natural direction with the tibia.

§ 25. The effect of this simple apparatus is very easily understood. The *horizontal* spring, fixed about its middle to the *fulcrum*, may be considered as if there were two springs, one of which extended from the centre of union of the *fulcrum* to the point of the foot, the other from the *fulcrum* beyond the heel. The first, by means of the anterior strap, acts constantly in bringing the fore part of the foot from within outwards ; the other, by means of the posterior strap passing upon the anterior surface of the neck of the foot, and united to the top of the *fulcrum*, continually exercises a force, by means of which the internal tuberosity or superior apex of the *os naviculare*, turned morbidly upwards, is turned from

* Plate II. Fig. II. h.

† Plate II. Fig. II. i.

above downwards, and from the outer to the inner side of the foot, and therefore insensibly brought below the internal malleolus to its natural position along the inner margin of the foot, and transversely to the upper part of the foot. In this position only the articular cavity of the *os naviculare* can receive and completely cover the articular head of the anterior tuberosity of the *astragalus*, and consequently correct the irregularity of the upper part of the foot. Farther, the *semicircular* spring, or the *fulcrum*,* as it runs for a certain space under the outer margin of the sole of the foot, contributes, when the child stands or walks, to raise and suspend, to use the expression, the outer margin of the foot from the ground, and therefore assists in turning round the *cuboides* and the *cuneiform* bones, together with the heads of the *metatarsal* bones, from below the sole of the foot outwards, *i. e.* to their proper and natural position with the tibia and external malleolus.

§ 26. This apparatus, which ought to be applied day and night, does not prevent the child standing, or walking about; nor when he walks does it occasion any more inconvenience than when he sits; because the *horizontal* spring, oscillating during the alternate pressure of the foot on the ground, yields to the deformed position of the foot, at the same time that it insensibly corrects it, and brings it back to its natural direction with the leg. The action of walking

* Plate II, Fig. II. III. a.

even facilitates the cure, in so far as it contributes to raise the outer margin of the foot which rests upon the semicircular spring, and, loading still more the *horizontal* spring, increases its tension. In this respect, it does not make any remarkable difference, whether the point of the foot be merely turned inwards, or inwards and upwards, as is seen in the plate given by Hildanus,* where he speaks of this sort of deformity of the feet; for the *horizontal* spring, kept parallel to the ground, acts the double purpose of reconducting the point of the foot outwards, and of pressing it to the ground if required. That the above described elastic apparatus actually produces the two advantages above mentioned, viz. of raising the outer margin of the foot from below the sole outwards, by turning around their axis the *os cuboides*, the *cuneiform*, and the heads of the *metatarsal* bones, and that of turning the internal tuberosity or apex of the *os naviculare* from the outer part of the foot inwards, and from above downwards, in the direction of the internal margin of the foot, and from below the internal malleolus, is proved in the most convincing manner. In the first place, we observe, during the treatment, that the callosity of the skin, previously situated under the outer margin of the foot, is gradually removed to the dorsum of the foot. In the second place, we perceive that the *external* malleolus, which almost touched the ground, gradually assumes a more elevated position, corresponding to the height of the neck of

* Centur. VI. Observ. 90.

the foot. In the third place, we remark, that the *internal* malleolus, which previously scarcely appeared, from being concealed by the apex and tuberosity of the *os naviculare* turned upwards, gradually protrudes during the cure, and the upper part of the foot, which was previously deformed by the prominence formed by the denuded articular head of the *astragalus*, assumes its regular shape.

§ 27. This first stage of the treatment, in children from three to four years of age, is completed, for the most part, in two months, if due care be employed. In course of time, if the *horizontal* spring have become too weak, it must be replaced by a similar one, of greater elasticity and power; precautions being always taken, that the apparatus never occasions pain to the child, from being too tight, or from being in any way displaced.

§ 28. Towards the end of this first stage of the cure, although the fore part of the foot be brought back to its proper position with regard to the leg, or even more outwards than natural, as in the *valgi*, nevertheless the posterior tuberosity of the heel, in which the tendo Achillis is inserted, seems still awanting, because it is turned inwards, or drawn upwards by the unusually tense tendo Achillis, placed in an oblique direction from the outer to the inner side of the leg. At this period commences the second stage of the cure, which I am now to describe, consisting in the application of the second apparatus. This, properly speaking, is merely

the first with some modifications, and with the addition of a third *spring*, the action of which is intended to supply the place of the *peronei* muscles, and to bring the body, and posterior tuberosity of the *os calcis*, more outwards than was procured by the first apparatus, and at the same time to retain the tibia and fibula perpendicular to the *astragalus*.

§ 29. The following are the different parts composing this second elastic apparatus. A slipper, the posterior quarter of which * is formed by a nearly parabolical *spring* of fine flexible elastic steel plate, incloses the heel. The inner side of this spring is a little shorter than the outer; the former extending to the internal malleolus, the latter to the external. The end of each of these sides is bent slightly outwards, that the skin of the foot may not be injured. The height of the *parabolical* spring is such as to allow, during the cure, the posterior tuberosity of the heel to descend, and sink deep into it. To the bottom of the *parabolical* spring is sewed a sole of leather, which extends along the whole sole of the foot, † and reaches above the edge of it all round, and is kept in its place by one or more ribbons, tied on the dorsum of the foot. ‡ The *parabolical* spring is kept in its place around the heel by a padded strap, § which passes round the neck of the foot. The *parabolical* spring

* Plate III. IV. Fig. I. *a. a.*

‡ Plate III. *c.*

† Plate III. *b. b.*

§ Plate III. *d.*

is likewise lined with soft flannel, and covered with fine glove leather. On the outer side of this spring there is a *fulcrum* or point of rest with a screw,* similar to that of the first apparatus,† under which the *horizontal* spring is made to run forwards or backwards, and is fixed at pleasure, by means of the screw.

§ 30. To the posterior extremity of the *horizontal* spring, ‡ as in the first apparatus, is sewed a strap, § which passes round the heel exterior to the *parabolical* spring, and is fixed to the inner side of this spring by means of a small knob, placed there for that purpose. To the anterior extremity of the *horizontal* spring || is attached the anterior padded strap which surrounds the fore part of the foot at the root of the toes, exactly as in the first apparatus. On the outer side of the *parabolical* spring there is a perpendicular slit, ¶ about three or four lines in length, in the situation and direction nearly corresponding to the external malleolus, which serves to unite, or rather to articulate together the *parabolical* spring with the *perpendicular*, as I shall now point out.

§ 31. The *perpendicular* spring** extends from the outer side of the *parabolical* spring upwards along the external

* Plate III. *e*.

† Plate III. Plate IV. *h*

|| Plate III. *g*.

** Plate III. IV. *k*.

‡ Plate II. Fig. II. III. *e*.

§ Plate III. *f*.

¶ Plate IV. Fig. II. *b*

malleolus and the fibula, as far as the external tuberosity of the tibia. The inferior extremity of the *perpendicular* spring has a pin* in the form of the letter T, which passes into the slit formed in the outer side of the *parabolical* spring. The pin is made to enter, holding the spring horizontally; then raising the spring perpendicularly, or along the leg, the pin passes through the slit, and thus forms between the two springs a sort of union, or, as I said, an articulation, which leaves the foot at liberty to perform the motions of flexion and extension. The *perpendicular* spring is kept in a state of moderate tension, along the outer side of the leg, by means of two segments of fine steel plate, padded,† and provided with a resting point, with a screw,‡ and straps § similarly lined. The *perpendicular* spring ought to possess a moderate degree of elasticity, otherwise it cannot be adapted to the outer side of the leg; for if it were applied forcibly, it would occasion pain and uneasiness. The inferior || resting point of this spring is placed in the lower third of the leg, or a little lower, according as it is wished to make the lower extremity of this spring exercise less or more force, in raising, suspending, and carrying outwards the outer side of the *parabolical* spring, and along with it the body of the *os calcis*, and its posterior tuberosity.

* Plate IV. Fig. II. *b*.

† Plate III. *n. n.*

|| Plate III. *b*.

† Plate III. IV. Fig. I. *l. m.*

§ Plate III. *o. o.*

§ 32. This second apparatus, as I have already said, is merely the first with some modifications, and the addition of the *perpendicular* spring. Having covered the foot and leg as far as the knee with a boot of glove leather, the curved heel is made to descend as far down as possible into the *parabolical* spring,* and immediately this spring is fastened on the neck of the foot by means of the strap intended for that purpose. † If the outer side of the *parabolical* spring at its point, although turned outwards, presses upon the skin of the foot too much, it may be twisted a little more out, and a small cushion of linen ‡ may be placed between it and the foot. The leather sole§ is likewise to be fixed to the neck of the foot. Then the *horizontal* spring || is passed forwards, and fixed by means of the screw. ¶ The posterior extremity of the *horizontal* spring is united to the inner side of the *parabolical* spring by means of the strap; ** in the same manner to the anterior extremity of the *horizontal* spring is fixed the anterior lined strap, †† intended for keeping the fore part of the foot outwards. After this, the inferior extremity of the *perpendicular* spring, holding it horizontally, is applied to the outer side of the *parabolical* spring; ‡‡ then the *perpendicular* spring is raised up, pressing it gently, so as to adapt its convexity along the outer side

* Plate III. *a. a*

‡ Plate III. *p.*

|| Plate III. *h.*

** Plate III. *f.*

‡‡ Plate III. *i.*

† Plate III. *d.*

§ Plate III. *b: b. c.*

¶ Plate III. *c:*

†† Plate III. *g.*

of the leg, where it is fixed by means of the two segments of the steel plates padded and provided with a screw.* These segments are tightened to the leg, more or less, according as it is wished to give more or less elasticity to the *perpendicular* spring.

§ 33. It is evident, that this second apparatus, if carefully applied, and with proper attention that the springs at first are neither too strong, nor too much stretched, ought to produce the triple benefit, *first* of keeping the fore part of the foot outwards; *secondly*, of correcting the position of the *os calcis*, by making it turn round its axis, so that its posterior tuberosity, in which the tendo Achillis is inserted, is brought from within outwards, and from above downwards; and, *thirdly*, of balancing sufficiently the muscular powers common to the leg and foot, so that they may become capable of keeping the leg steadily perpendicular upon the *astragalus*. For the *horizontal* spring, the point of rest of which is on the outer side of the *parabolical* spring, continually acts in keeping the fore-part of the foot outwards; and it does so without occasioning the least inconvenience to the patient, both because the resting point of this *horizontal* spring does not fall upon the skin of the foot, but on the outer side of the *parabolical* spring, and because this point of rest is situated at a greater distance from the convexity of the spring, and from the resistance, than in the first ap-

* Plate III. *l. m. n. n. o. o.*

paratus. And there is no occasion for a greater force, because the fore part of the foot is already brought back to its proper position, by means of the action of the first apparatus. The *perpendicular* spring acts continually, raising and suspending, to use the expression, at the same time, the outer side of the *parabolical* spring, and the external edge of the body of the *os calcis*, which it of course brings back in a circular manner, along with its posterior tuberosity from within outwards. This, in so far as regards the posterior tuberosity of the *os calcis*, in which the tendo Achillis is inserted, takes place the more readily, the more that the child, in placing the foot to the ground, causes the inner side of this spring to tend always to force the posterior tuberosity of the *os calcis* from within outwards, the weight of the whole body gravitating upon the inner side of the *parabolical* spring, more than upon the outer side. Farther, the *perpendicular* spring keeps the leg steadily perpendicular to the *astragalus*, by means of the point of rest that this spring has at the upper part on the external tuberosity of the tibia, and at the lower part on the outer side of the *parabolical* spring to which it is fixed and articulated; that is, on the outer side of the body of the *os calcis*. This perpendicular spring supplies the action of the *peronei* muscles, both with respect to the raising and keeping suspended from the ground the outer margin of the foot, and re-establishing the equilibrium between the *tibiales* and *peronei* muscles, upon which equilibrium depends the preservation of the proper direction of the foot with the

tibia, and the perpendicular position of the leg on the *astragalus* in standing and walking. Lastly, the artificial force, which, by means of the *perpendicular* spring, is substituted for what is wanting in the *peronei* muscles, combined with that exercised by the *tibiales*, contributes greatly to assist the direct flexion of the foot on the tibia, and to overcome the resistance opposed by the tendo Achillis, and thus promotes the descent of the posterior tuberosity of the *os calcis* to the ground, in the due direction and situation with the sole of the foot.

§ 34. We have sufficient evidence, that, during the action of this second elastic apparatus, the heel is drawn from within outwards, and from above downwards, so that its posterior tuberosity, in which the tendo Achillis is inserted, at last touches the ground in a proper direction with the rest of the sole of the foot. This evidence is derived, from observing, during the progress of the cure, the state of the heel, which, at the beginning of the second stage of the treatment, seemed entirely wanting, owing to its being turned to the inner side of the foot, and situated obliquely in the hollow of the *parabolic* spring, in the bottom of which no appearance of heel was either felt or seen. In the course of time, and shortly after the application of the second apparatus, we begin to feel, on pressing, under the bottom of the *parabolic* spring, a slight prominence, and then we observe distinctly the posterior tuberosity of the *os calcis*; and lastly, we find, in the sole of the foot, the hollow left by the

os calcis. We observe, at the same time, that, in proportion as the posterior tuberosity of the *os calcis* is brought from the inner to the outer side of the foot, and is depressed into a proper direction with the sole of the foot, the tendo Achillis also, which was in an oblique line from the outer to the inside of the leg, takes a perpendicular direction, parallel to the posterior surface and inferior extremity of the tibia.

§ 35. This second apparatus, in the same manner as the former, allows the child the complete power of standing and walking; and possesses, like the first, the important advantage, that the more the child walks, the more his cure is promoted. It is proper to mention, that this second stage of the treatment requires double the time in general that the first does; that is, if three months are required for bringing the fore part of the foot into its proper direction with the tibia, six more will be necessary for bringing the posterior tuberosity of the heel to the ground, and into its exact natural position with the rest of the sole of the foot. We ascertain that the cure is completed, from observing, that the heel and the tendo Achillis are in their proper position; that the child walks and runs freely without stumbling; and that, in walking, he keeps his feet rather more outwards than usual, and in the manner of the *valgi*.

§ 36. This second part of the treatment, as well as the first, requires merely attention, on the part of the surgeon who attends the child, to increase the strength of the spring

gradually to a proper degree, and that the apparatus be not displaced, either during the day or night. Farther, the whole of this second stage of the cure is effected with such gentleness, that the child never complains of pain in his feet or legs, and does not appear unwilling to allow the apparatus to be applied, as he is soon accustomed to wear it. In proportion as the deformity is corrected, and as he acquires firmness in keeping himself erect on his feet, the more he acquires courage in moving about, in walking and running. The cure having proceeded in this manner, laying aside every sort of machine, the child is merely made to wear, for a year, boots of leather, without any heel, to be laced on the dorsum of the foot, as far as the middle of the leg, which boots are made differently from the common, in this respect, that the outer edge of the sole is a little thicker, and more raised than their inner margin. In this manner the foot and leg continue, for a length of time, to remain elevated and suspended from the ground, on the outer side, and, consequently, the muscles and ligaments of the foot recover their strength.

§ 37. Venel did not undertake the cure of any child affected with this deformity, who had passed the age of seven years.* I am convinced, that, by employing the above de-

* Huit Planches représentant chacune des genres differens et distincts des deformités des membres, par Venel.

scribed elastic apparatus, we may have confidence of success, even in those who have reached the age of ten or twelve years. It is in general true, that the younger the children, the more favourable are the circumstances to their cure. Hippocrates* remarked it, and good sense suggests it. Besides, it is well known, that in persons affected with this deformity, and arrived at an advanced age, the flexion and extension of the foot being very slight, or entirely prevented, a true *anchylosis* must, of necessity, take place at the joint formed by the *naviculare* with the articular head of the *astragalus*, as well as in that between the *astragalus* with the *tibia* and *fibula*. This state, however, rarely takes place before the age of puberty. †

§ 38. In speaking of Hippocrates, this appears to me a proper place for quoting another passage of his book *De articulis*, in addition to the above mentioned, from which, if I am not very much mistaken, we may conclude, that the Father of Medicine approached very nearly to the truth in proposing, as he did, the indications of cure of this defor-

* *Lib. de articulis*, sect. vi. Quicumque a natiuitate mutili fiunt, plerique ex iis curabiles sunt, si non valde magna emotio facta fuerit, aut etiam præauctis jam pueris contigerit. Optimum igitur est ut talia quam celerrime curentur priusquam admodum magnus carnium defectus circa tibiam contingat.

† I do not think it necessary to add any detailed description of the mode of applying this apparatus in the event of a case occurring of the disease called *Valgi*, *i. e.* with the point of the foot turned outwards, as it will be easily understood, that, in the circumstance of this deformity, the *fulcrum* ought to be placed on the inner side of the foot.

mity, and the means for correcting it. “Animadvertendum autem in horum curatione est,” said the Sage of Cos, “ut tibiæ circa maleolum os quod extrinsecus est, ad internam partem detrudatur ac dirigatur, ut calcanei os quod e directo illi subjacet ad externam partem retrudatur, quo ossa quæ eminent sibi ipsis occurrant juxta medium ac obliquum pedem. Digiti vero accervati, una cum magno digito ad internam partem inclinentur, atque ita circumcirca cogantur. Prope autem deligare oportet cerato resinato, et spleniis, et linteis mollibus non paucis, neque nimis compressis; atque ita deligationis circumductiones facere veluti etiam manibus directio pedis fiebat, quo pes paulo magis ad valgum vergere videatur. Soleam etiam quamdam facere oportet, aut ex pelle non nimis dura, aut ex plumbo, eamque insuper adligare non ad *corpus* * positam, sed ubi jam postremis linteis deligare voles. Quum vero jam deligatus fuerit, unius alicujus linteï ex his quibus deligatur initium ad deligamenta, quæ infra pedem sunt adsuere oportet e directo parvi digiti, et postea sursum extendere, ita ut moderate habere videatur; atque sic supra suram circumdare, quo sic extentum, et collocatum stabile maneat. In summa, quasi quis ceram fingat ad naturam justam adducere oportet, ita ut et inclinata, et distenta præter naturam et manibus sic deligamus, et similiter deligatione: adducamus autem non violenter, sed leniter. Adsuere vero ita oportet lintea ut conducant ad reparationes ac appren-

* Foesius. Non ad *cutem* positam.

siones * faciendas. Aliæ enim claudicationes alia reparatione opus habent. Calceum insuper plumbeum facere oportet extra deligationem adligatum, qualem modulum crepidæ chiæ habebunt. Verum nihil ipso opus est, si quis et manibus recte direxerit, et linteis recte deligaverit, et appensiones, et reparationes per adsuta lintea recte fecerit. Atque hæc quidem est curatio; et neque sectione, neque ustione, neque alia varietate quicquam opus habet. Citius enim talia medicinæ obtemperant quam quis putaverit. Devincere tamen tempore oportet, donec in justis figuris corpus auctum fuerit."

§ 39. The general indication of cure established by Hippocrates, to reconduct *congenital club feet* to their proper position, with such gentle methods, by means of bandages, as one would model wax with the hand, could not have been better selected nor more clearly expressed. With regard to the mode to be employed for this purpose, he taught, that some bandages were to be sewed to the sole of leather, opposite to the little toe, and these brought upwards so as, to use the expression, to *suspend* the outer margin of the foot, and turn it in a contrary direction to that which the deformity had occasioned. This sort of bandage, it appears to me, corresponds to the *perpendicular* spring of the second elastic apparatus, above described. Hippocrates has not failed, as I have ob-

* Foesius. Ita vero fasciæ assuendæ, ut quemadmodum opus est membrum excipiat.

served above, § 6, to distinguish, in the book quoted, *congenital* deformities from those which are the effect of dislocations imperfectly or not at all replaced. In regard to this point, I cannot comprehend for what reason M. A. Severinus, a man, in other respects, well versed in the literature of the ancient physicians, and especially of Hippocrates, in his book *De recond. Absc. nat.* cap. vi. *de Gibbis, Valgis, Varisque*, has said: “ Apud antiquos, qui sunt omnes Græcos, Latinos, Barbarolatinos, Mauros, Arabos, Poenos, qui vel omnem medicinæ præceptionem, vel nobilem hujus quamcumque partem tradiderunt, incertum est cui malæ conformationis generi, vel speciei hanc quam discutimus retulerint, apud quos nimirum ea de re ne verbum quidem,” when, as has been mentioned, Hippocrates has not only given a correct idea, with regard to the essence of these deformities of the feet, but has left, in his writings, the general indications of cure of this deformity, and has pointed out some means adapted for curing it.

§ 40. Although the object of this Memoir is only to treat of the *congenital* distortions of the foot, nevertheless, for the benefit of the young student, I shall add a few remarks on those cases, in which the deformity has taken place after birth, from internal or external causes.

§ 41. I consider incurable those distortions of the feet produced by Rachitis, in consequence of which, not only the bones of the feet are deformed in their structure, figure,

and connexions, but those of the leg, thigh, or pelvis, are likewise distorted and bent in an unnatural manner. I have likewise no confidence of curing those distortions of the feet occasioned by *white swelling*, with thickening of the ligaments, and evident enlargement of the articular heads of the bones ; of those which are the melancholy effect of a chronic rheumatic, or gouty affection ; of those, in short, which are the consequence of luxations, either insufficiently reduced or not reduced, and neglected for a long time after the accident, which have been followed by union of the articular heads to each other, and consequent impossibility of restoring the motion of the joint.

§ 42. On the other hand, in my opinion, those recent distortions of the feet are susceptible of cure, which have been produced by an awkward placing of the foot on the ground in walking, continued for a length of time, and likely to become habitual ; those occasioned by extreme debility of the ligaments and of the muscles of the one or other side of the leg, intended for moving the foot ; and finally, those produced by luxation, although speedily replaced, but which has, nevertheless, left at the joint of the foot with the leg a tendency to distortion of the foot.

§ 43. Bruckner * relates the history of a man, 64 years of

* Ueber einwärts gedrehte Füße, und deren Behandlung, besonders nach Dr Venel's Methode.

age, who had had variolous pustules on the sole of his right foot, which, in course of time, prevented him walking in any other way than on the outer edge of his foot. This mode of walking having become habitual to him, his right foot at last became distorted inwards. The same author speaks of a girl, seven years of age, who had been affected, for a long time, with a superficial ulcer on the internal margin of the foot. To prevent her suffering pain, she walked for some time on the outer edge of the foot, and at last, as in the man above mentioned, the foot became twisted inwards, and the leg very much emaciated. This girl was completely cured by the application of Venel's apparatus. From this fact, therefore, I would not hesitate to conclude, that the man might have been also cured by the same means, if, as in the case of the girl, the cure had been undertaken in time.

As a proof of this, I add the following case:—On the 1st of January 1804, Maria Savio of San Leonardo, a girl ten years of age, applied for advice at this Clinical School of Surgery, having her right foot very much deformed and turned inwards. Her mother mentioned, that towards the end of May of the preceding year, the girl, walking with bare feet, a thorn ran into the sole of the right foot, near to the inner edge of the foot. Some time after this accident the thorn was removed; but, nevertheless, the foot around the place of the injury inflamed, suppurated, and a slight superficial ulcer formed, which was more than a fortnight in healing. During this time, the poor girl being obliged to stand on her feet, walked at first on the point of the right

foot ; then finding it less inconvenient to walk on the outer margin of the foot, continued to do so, and acquired such a habit, that, seven months after the extraction of the thorn, her foot was found very much deformed, and turned inwards, without having the power of turning it right at pleasure. On the 3d January, the first apparatus was applied to this girl, by means of which, gradually increasing the strength of the *horizontal* spring, in the course of three weeks, the point of the foot turned inwards, was by degrees brought back to its natural direction with the corresponding tibia. The second apparatus was then applied, by the assistance of which, the child walked even more freely and quickly than she had done during the first period of the cure. In three weeks, on removing all the apparatus, the little patient placed the point of the foot correctly to the ground; and it was worthy of remark, that, standing erect or walking, she marked her right foot to the ground better than her left. She continued the use of the second apparatus for two months, in order to obtain a permanent cure, which was completely effected.

§ 44. In practice, we not unfrequently have occasion to observe, that, in cases of simple or compound fractures, or of severe contusions or wounds of the leg, in consequence of which it is necessary to place the injured leg on its outside, in the manner directed by the late Mr Pott ;—it happens, I say, that the patients cured of similar misfortunes, when they get out of bed, have the foot very

sensibly turned inwards, and walk on its outer margin. It appears to me, that this species of distortion, which occasions so much inconvenience to the patient on first leaving his bed, and so much anxiety to the surgeon, may be corrected in a shorter time, by means of the apparatus I have described for the first stage of the cure of the *congenital club foot*, than by the use of topical astringents and tonics alone.

§ 45. Children not, properly speaking, rickety, but of a delicate constitution, and which, in consequence of debility of the ligaments, or flaccidity of the muscles which move the foot on the leg and the leg on the foot, have a difficulty in walking, and in walking are threatened with having their feet distorted, may derive very great advantage from the application of the second apparatus which I have described, or that which has in view the keeping the foot in a proper direction with the tibia and with the external malleolus, and the leg exactly perpendicular on the *astragalus*.

§ 46. After a complete luxation of the foot, the ligaments are sometimes ruptured, by the violence causing it, on one side, or they are, for a long time afterwards, unusually stretched and debilitated. It not unfrequently occurs, that at the part where the bone has passed out of its place, the ligaments and tendons inflame along with the other ligamentous and soft substances covering them. By the uninterrupted use of mild emollient topical applications during the inflammatory

stage, and after it is subdued, by employing astringents and tonics, these symptoms are indeed very often removed, after which the patient is considered as cured. But as soon as he begins to get out of bed, he finds that he does not place his foot on the ground with the same precision that he did before the accident, and the surgeon observes, that the foot which has been dislocated, although completely reduced, is daily deviating from its natural direction with the tibia. Both the surgeon and the patient flatter themselves, that, in course of time, by the use of warm fomentations and the shower bath, the whole will be restored to its former healthy state: But both are frequently deceived; for, notwithstanding the use of these means, the foot remains distorted, or becomes still more deformed. Jackson* relates three cases successfully cured by the application of his machines, intended for curing the congenital club feet of children, the nature of which machines, however, he still conceals. The first case is that of a boy, eight years old, who, a year before, had dislocated his foot forwards by a fall down stairs; in consequence of this accident, the point of the injured foot was inclined downwards, and the heel upwards, and he could not walk without the assistance of a crutch. The author assures us, that, by means of the application of his mysterious apparatus, the boy, in a short time, was able to

* Observations on the inefficacious use of irons in cases of luxations, and distortions of the ankle-joint, and children born with deformed or crooked feet.

substitute a stick instead of a crutch, and, at last, to put the whole sole of his foot to the ground, and to run and leap along with other boys, without having occasion for any support. The second case was that of a lady, 26 years of age, who had met with a *twist* of one foot towards the inner angle. This patient had been treated according to all the best rules of art ; but, when she supposed herself cured, she found her foot bent towards the inner angle. In a few weeks, the foot of this lady, by means of the use of Jackson's machine, was permanently brought to its proper direction with the tibia, and she was enabled to walk as well as before the accident. The third case was that of a boy, about seven years of age, who, three years before, had had the misfortune to get his left foot crushed between the wall and the door, at the moment that a servant was shutting the door very forcibly. The foot of this boy had remained twisted to the outer side, and the rest of the limb was very much emaciated. After various external remedies had been tried without effect, the author undertook the cure of him, and, as he says, had the good fortune, in a much shorter time than he had flattered himself, to bring the foot to its natural position, and to see him place the whole sole of the foot accurately on the ground. Although Jackson does not give the slightest hint, which might lead to the knowledge of the mechanical means which he employed for obtaining these successful cures, it appears to me, that we need not now much regret this concealment. For, if I be not very much mistaken, the apparatus which I have

described is sufficient, in cases similar to those above quoted, to produce the same benefit as was obtained by Jackson ; that is to say, that it may prove beneficial, not only in cases of *congenital club feet*, but even in some other circumstances in which the deformity of the feet has been produced by a bad habit in walking, or by debility of the muscles and ligaments which go from the leg to be inserted into the foot ; in those occasioned by a long improper position on the outer side of the leg, by luxation imperfectly reduced, or by the consequences of such an accident.

§ 47. With regard to the first case related by Jackson, where he speaks of a dislocation of the foot anteriorly, and in consequence of which, the point of the foot was inclined downwards, and the heel raised upwards, this is the only case of those related by this author, for which neither of the two machines I have described would appear to be adapted. Both in this, and in the other species of *congenital* distortion of the foot, with the point downwards, called *HORSE foot*,* I am of opinion, that great benefit would be derived from the placing a *spring* under the sole of the foot, so that the more the little patient walks, the more the *spring* would re-act upon the root of the toes, and the fore part of the foot, so as to raise its point, and force it upwards into a proper direction with the heel.

* Pied équin. Andry, Orthopœdie. T. I. page 88.

This apparatus, which I intend to try on the first favourable opportunity which shall occur, is the following :—Having covered the foot and leg with a boot of glove leather, a *parabolic* spring embraces the heel.* This spring is kept in its place by means of two straps, one of which, † attached at the upper part to the extremity of the inner side of this *parabolic* spring, surrounds the lower end of the leg above the joint of the foot, and is fixed at the upper part to the outer side of the *parabolic* spring ‡. The other strap, § fixed to the inferior extremity of the inner side of the *parabolic* spring, passes upon the fore part of the foot, and is attached to the lower part || on the outer side of the spring. A sole of flexible leather is adapted to the sole of the foot, which is tied on its upper part. ¶ From the bottom of the *parabolic* spring, another spring** extends, the greatest convexity of which corresponds to the roots of the toes, and the inferior heads of the bones of the *metatarsus*. Between the *spring* and the sole of leather is placed a plate of thin cork †† sewed to the sole ; this plate is slightly hollowed out, and within the hollow of it, the *spring* situated under the sole of the foot, in the action of walking, or in the alternate pressure and raising of the foot, runs forwards and backwards without declining to either side. By this means, when the child places his foot on the ground, he rests the point of the foot

* Plate V. Fig. I. *a. a.*

† Plate V. Fig. I. *b. c.*

‡ Plate V. Fig. I. *d.*

§ Plate V. Fig. I. *e. e.*

|| Plate V. Fig. I. *f.*

¶ Plate V. Fig. I. *g. g. k.*

** Plate V. Fig. II. *c. c. b. g.* Fig. I. *i. h. m. h.* †† Plate V. Fig. I. *l.* Fig. II. *d. d.*

over the root of the toes upon the greatest convexity of the *spring*, which being compressed, yields, and is elongated; but at the moment of yielding, re-acts upon the fore part of the foot, which it forces insensibly upwards, until it is raised to its natural position with the sole of the foot and the heel. The elasticity and convexity of the *spring* placed under the sole of the foot, ought to be diminished or increased according to circumstances.

§ 48. According to these principles, upon which it appeared to me to be possible to establish a general rule with regard to the treatment of *congenital club feet*, and the most proper and most effectual mechanical means for obtaining the object, it will not be difficult to professional men to understand how the proper application of *springs* may be made to produce a double effect. This effect is, in the first place, the reconducting the parts, by degrees insensibly increased, to their natural situation; and secondly, by an artificial force to supply the natural debilitated action of the one or other class of muscles inserted into the parts displaced from their natural situation, it might be possible to succeed in correcting those deformities also, either *congenital* or which have come on after birth, of the joint formed by the superior heads of the tibia with the condyles of the femur, and with the patella, causing the knee to project too much either inwards or outwards. And in the same manner, they will understand how, by means of an elastic apparatus, it may be possible to

cure those deformities of the trunk, which proceed from a diseased inclination of the vertebral column. These points will form the subject of a second Memoir, as soon as experience shall have sufficiently pointed out the facts relating to this important class of deformities.

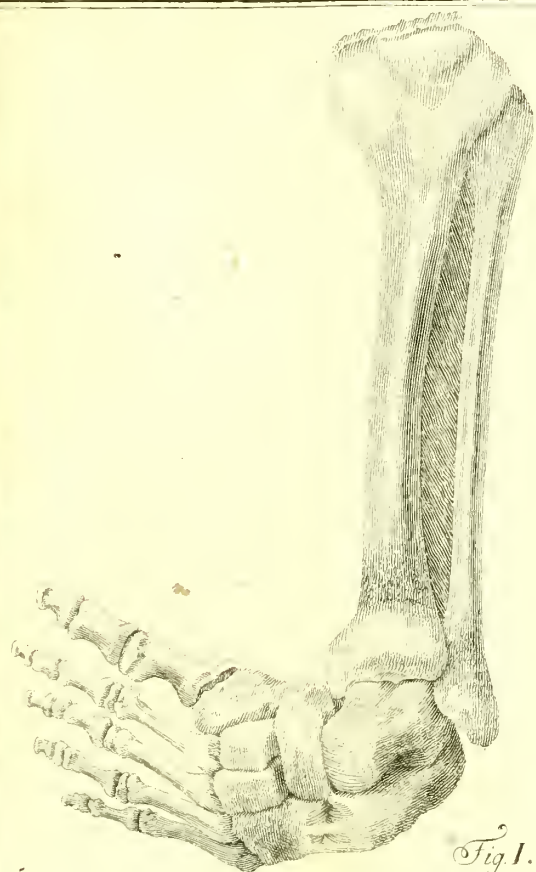


Fig. I.

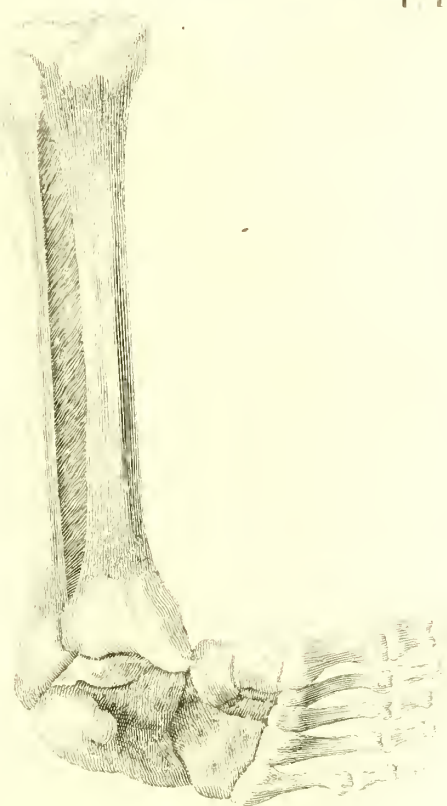
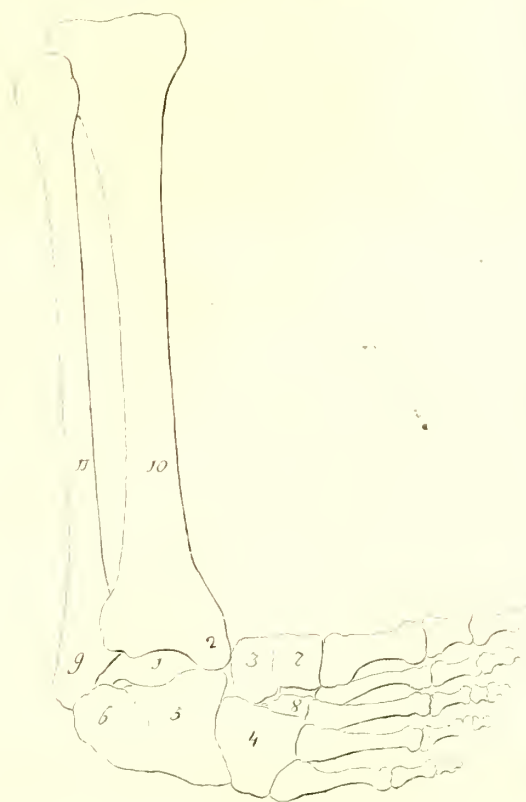


Fig. II.



EXPLANATION OF THE PLATES.

PLATE FIRST.

FIGURE FIRST.

1. The Tibia.
2. The Fibula.
3. The Malleolus internus.
4. The Malleolus externus.
5. The *Astragalus*.
6. The articular head of the *Astragalus*.
7. The *os Naviculare*.
8. The internal tuberosity of the *os Naviculare*.
9. The external tuberosity of the *Naviculare*.
10. The *os Cuboides*.
11. The anterior tuberosity of the *os Calcis*.
12. Ligamentous bands which unite the anterior tuberosity of the *os Calcis* to the *Cuboides*.
13. The *os cuneiforme magnum*.
14. The *os cuneiforme minimum*.
15. The *os cuneiforme minus*.

FIGURE SECOND.

1. The *Astragalus*.
2. The *Malleolus internus*.
3. The internal tuberosity of the *Naviculare*.

4. The *Cuboides*.
5. The anterior tuberosity of the *os Calcis*.
6. The posterior tuberosity of the *os Calcis*.
7. The *os Cuneiforme magnum*.
8. The apex of the *Cuneiforme minus* and *minimum*.
9. Malleolus externus.
10. The Tibia.
11. The Fibula.

PLATE SECOND.

FIGURE FIRST.

The Congenital Club Foot of a Child.

- a. The external Malleolus.
- b. The callosity of the outer margin of the foot.
- c. b. The morbid convexity of the outer margin of the foot, extending from the posterior tuberosity of the heel to the apex of the foot.

FIGURE SECOND AND THIRD.

The First Apparatus Separately, and in Situ.

- a. The semicircular spring, or *Fulcrum*.
- b. the *horizontal* spring.
- c. The posterior extremity of the *horizontal* spring.
- d. The knob situated on the anterior extremity of the *horizontal* spring.
- e. The screw intended for fixing the *horizontal* spring upon the *Fulcrum*.
- f. f. Two small knobs for fixing the strap g to the *Fulcrum*.
- g. The strap which passes from behind the heel over the upper part of the foot, and unites the posterior extremity of the *horizontal* spring to the two knobs on the *Fulcrum*.

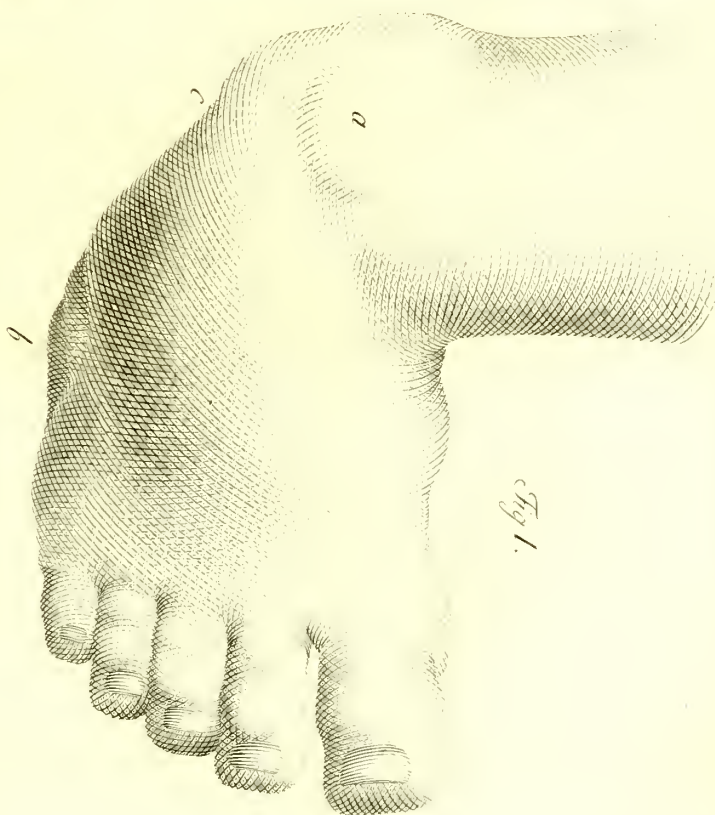


Fig. I.

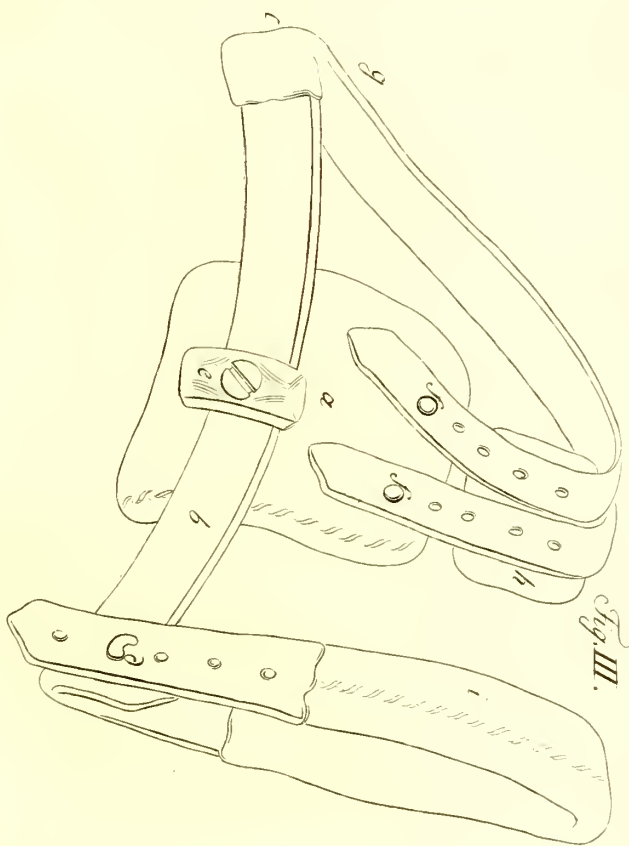


Fig. III.

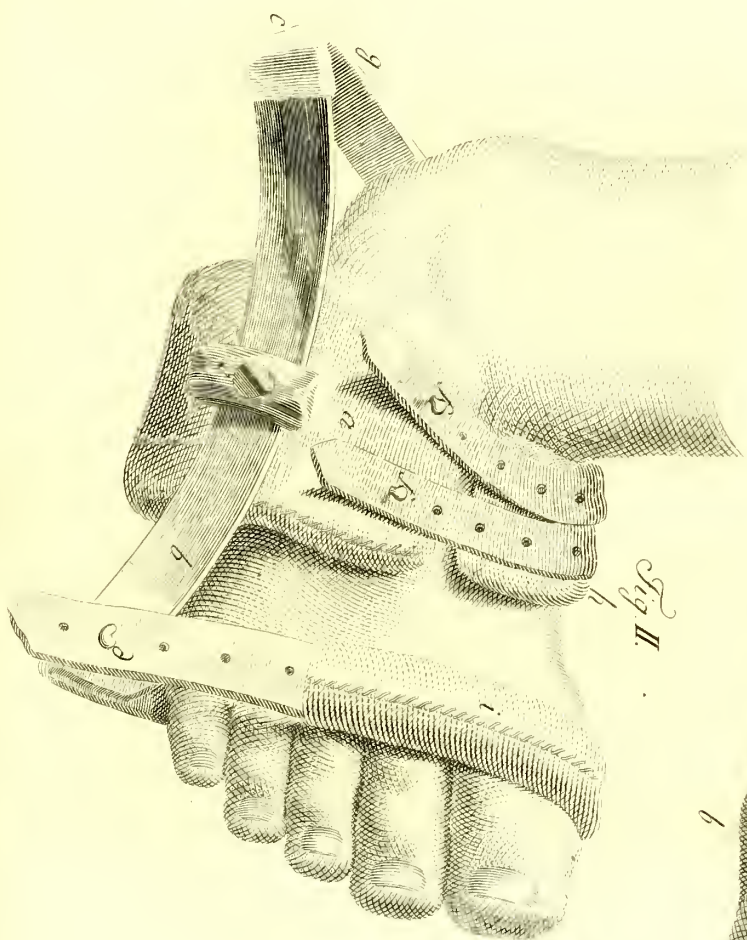
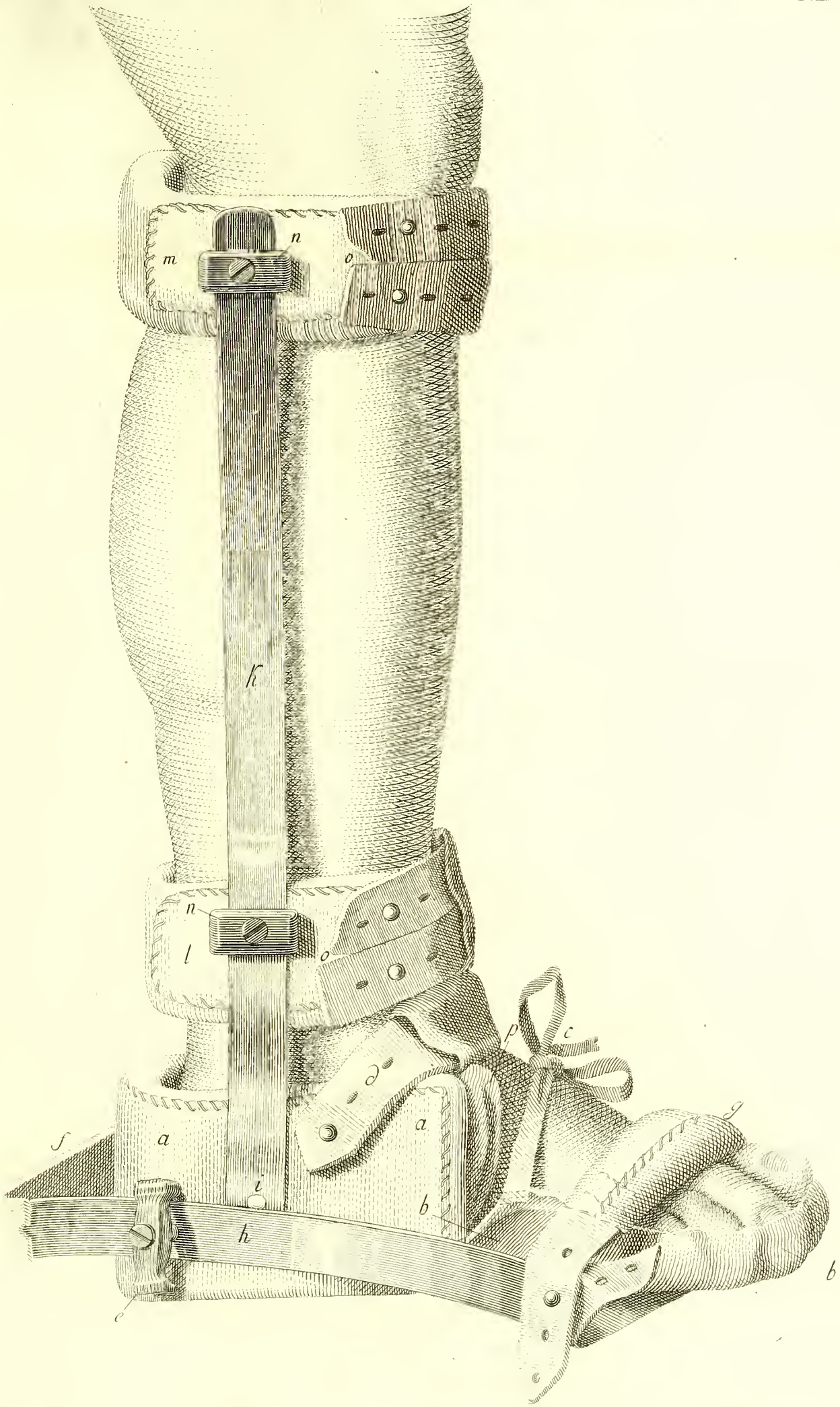


Fig. II.



- h.* A soft cushion of old linen.
- i.* The padded strap, which connects the apex of the foot to the anterior extremity of the *horizontal* spring.

PLATE THIRD.

The Second Apparatus in Situ.

- a. a.* The *parabolic* spring of the heel.
- b. b.* The sole of thin leather.
- c.* The tape which fastens the sole of leather to the upper part of the foot.
- d.* The padded strap, which ties the *parabolic* spring to the neck of the foot.
- e.* The point of support with the screw for fixing the *horizontal* to the *parabolic* spring.
- f.* The strap, which unites the posterior extremity of the *horizontal* spring to the inner side of the *parabolic* spring of the heel ; for this purpose, a small knob is placed on the inner side of the *parabolic* spring.
- g.* The padded strap for fixing the apex of the foot to the anterior extremity of the *horizontal* spring.
- h.* The *horizontal* spring.
- i.* The moveable connection of the inferior extremity of the *perpendicular* spring, with the outer side of the *parabolic* spring of the heel.
- k.* The *perpendicular* spring.
- l. m.* Two segments of steel plate padded, provided with a screw, and a double strap *n. n. o. o.* to serve as a point of rest to the *perpendicular* spring.
- p.* A soft cushion of old linen.

PLATE FOURTH.

FIGURE FIRST.

The Second Apparatus Detached.

- a. a.* The *parabolic* spring of the heel.
- b. b.* The sole of thin leather.
- c. c.* The tape, which ties the sole of leather on the upper part of the foot.
- d.* The padded strap, which fastens the *parabolic* spring to the neck of the foot.
- e.* The point of support for fixing the *horizontal* spring to the *parabolic* spring.
- f.* The strap, which unites the posterior extremity of the *horizontal* spring to the inner side of the *parabolic* spring; for this purpose, a small knob is placed on the inner side of the *parabolic* spring.
- g.* The padded strap for fixing the apex of the foot to the anterior extremity of the *horizontal* spring.
- h.* The *horizontal* spring.
- i.* The moveable connection of the inferior extremity of the *perpendicular* spring with the outer side of the *parabolic* spring of the heel.
- k.* The *perpendicular* spring.
- l. m.* Two segments of steel plate padded, provided with a screw, and with a double strap *n. n. o. o.* to serve as a point of support to the *perpendicular* spring.

FIGURE SECOND.

- a. a.* The *parabolic* spring for the heel.
- b.* The manner in which the inferior extremity of the *perpendicular* spring is joined with the outer side of the *parabolic* spring for the heel. Plate III. *i.* Plate IV. Fig. I. *i.*

Fig. I.

Fig. II.

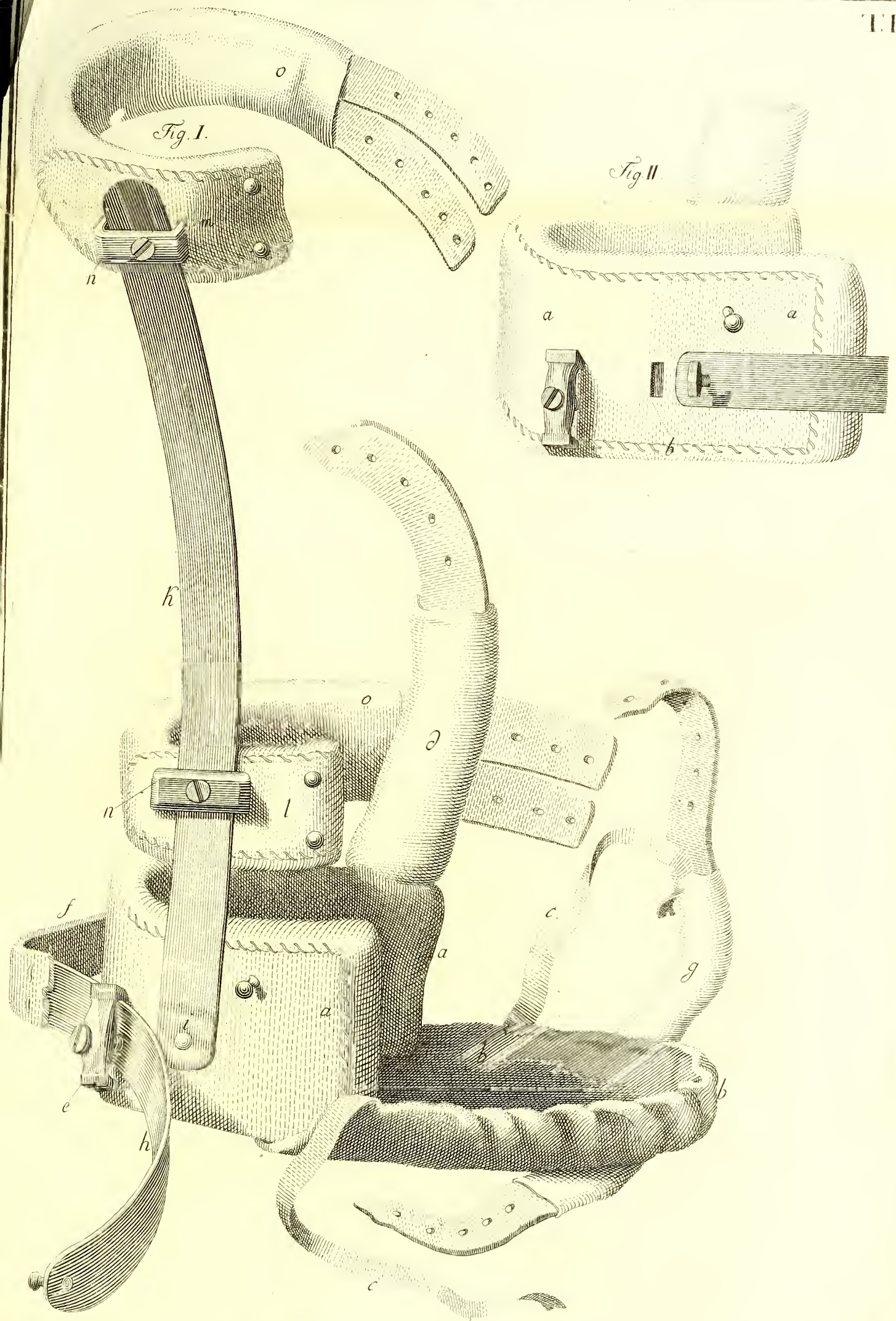


Fig. II.

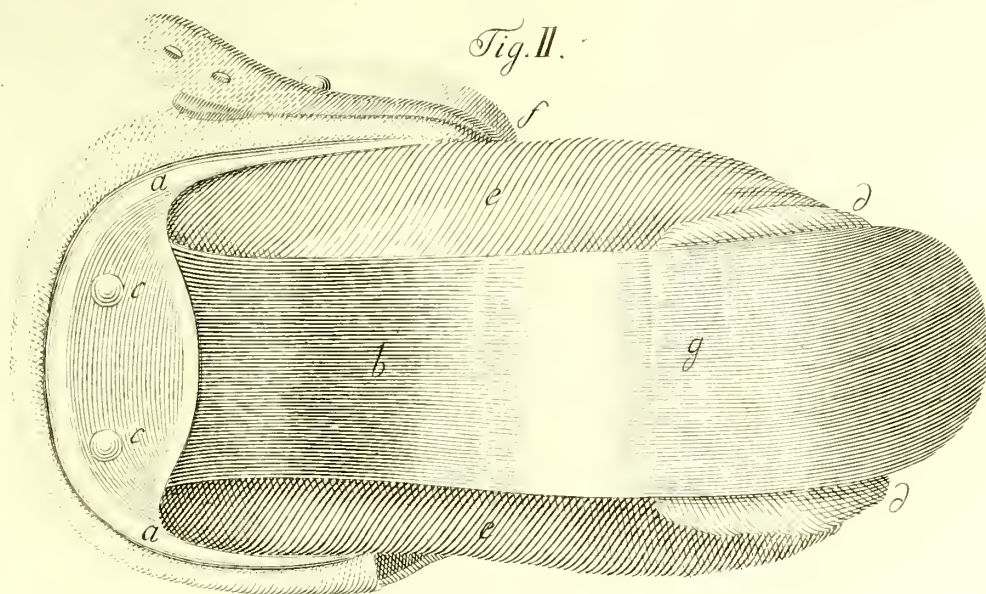


Fig. I.

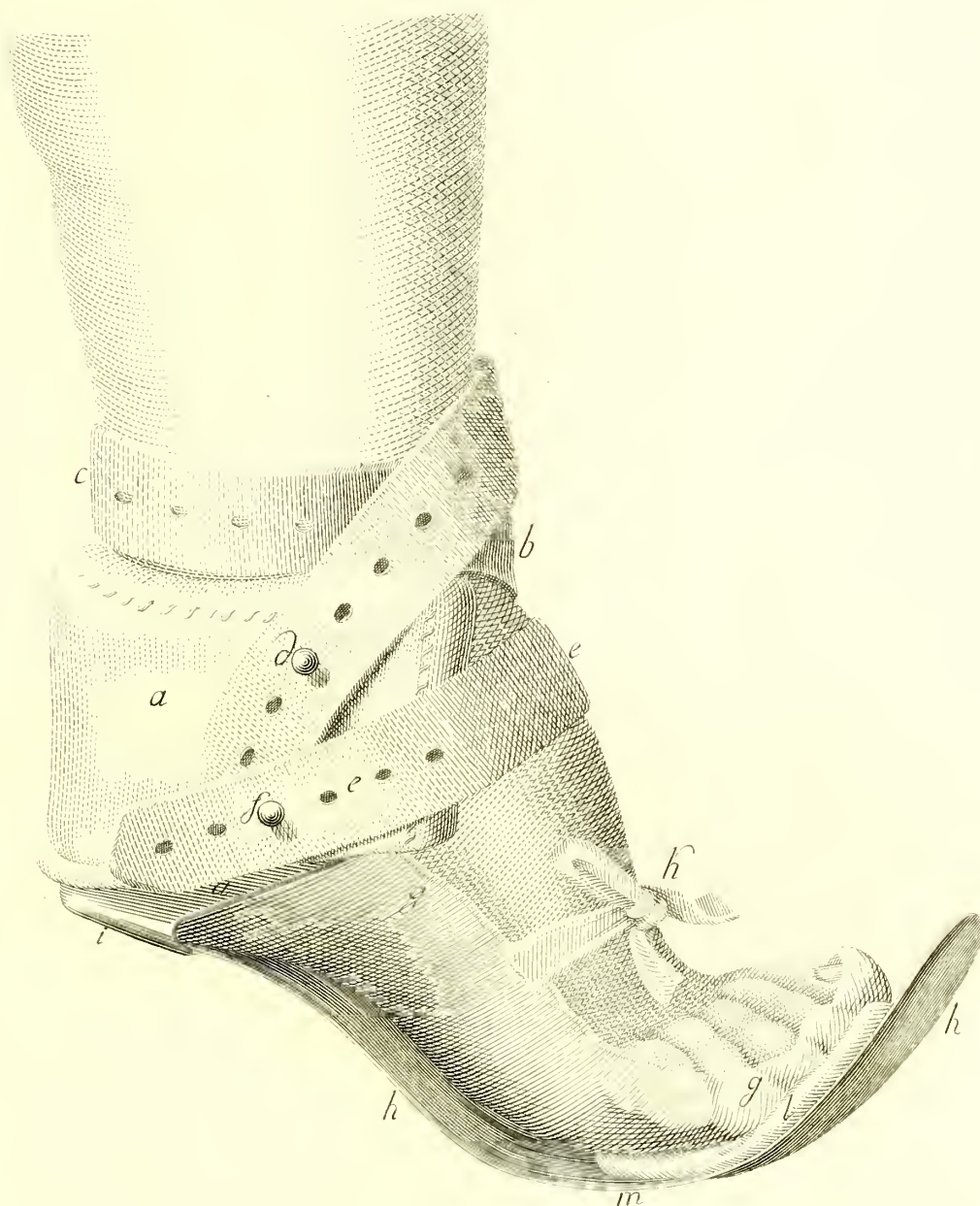


PLATE FIFTH.

FIGURE FIRST.

- a. a.* The *parabolic* spring for the heel.
- b.* The strap which passes from the top of the inner side of the *parabolic* spring, round the leg *c*, and is attached *d* to the outer side of the *parabolic* spring for the heel.
- e. e.* Another strap, which goes off below, from the extremity of the inner side of the *parabolic* spring, passes on the upper part of the foot, and is united at the lower part to the outer side *f* of the *parabolic* spring.
- g. g.* Sole of thin leather.
- h.* Curved spring situated under the sole of the foot.
- i.* The place of union of the curved spring with the *parabolic* spring.
- k.* The tape for tying the sole of thin leather to the upper part of the foot.
- l.* A piece of cork on which the spring runs, placed under the sole of the foot.
- m.* The greatest convexity of the spring situated under the sole of the foot.

FIGURE SECOND.

- a. a.* The *parabolic* spring for the heel.
- b.* The curved spring situated under the sole of the foot.
- c. c.* The point of union of the curved spring situated under the sole of the foot with the *parabolic* spring.
- d. d.* The piece of cork placed between the sole of leather and the curved spring.
- e. e.* The sole of thin leather.
- f.* The lower strap. Fig. I. *e. e.*
- g.* The greatest convexity of the spring situated under the sole of the foot.

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